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# APPENDIX 5

## COMPILATION OF EXISTING MONITORING PLANS

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## Appendix 5. Compilation of Existing Monitoring Programs

This appendix lists the key, relevant monitoring plans in Delaware which monitor key species, habitat or conservation issues that are a part of Delaware's broad monitoring framework. This list represents many partner programs and an important implementation and coordination part of this DEWAP effort to adaptively manage, incorporate, and communicate goals and data as each plan is revised and updated. Because monitoring will occur at the state, local, regional, national and international levels, it will require the establishment of this broad framework for monitoring at all of these levels. This will also allow partners to incorporate the SWG targets into their plans. This directly addresses Element 5 as well as Elements 6 and 7.

Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
<b>Mollusks</b>					
Eastern Oyster	Y	Dredging to determine status and trends of spat, juveniles and adults.	State-owned oyster grounds in Delaware Bay	Annual	FS
Freshwater mussels	P	Hand-picking of random plots to determine status and trends.	Freshwater streams statewide	Every 3-5 years (planned)	WS
Freshwater mussels	P	Rapid surveys covering large areas and quantitative surveys for detailed data about mussel abundance, size class, and health.	Freshwater streams in the Delaware Basin	On-going	PDE
<b>Arachnids</b>					
Horseshoe Crab	Y	Tagging; nocturnal counts of spawning individuals; radio tracking of spawning females; and plots of egg densities to determine status and trends.	Delaware Bay & selected beaches	Annual	CMP & WS
Horseshoe Crab	Y	Spawning surveys.	Delaware Bay & selected beaches	Annual	ERDG
Horseshoe Crab	Y	Spawning density.	Inland bays	Annual	CIB & UD

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
<b>Insects</b>					
Frosted Elfin	Y	Habitat quality and persistence for known populations. Also surveys of suitable but unoccupied habitat.	Selected locations in Sussex County	Annual	WS
Hessel's Hairstreak	Y	Habitat quality and persistence for known population. Also surveys of suitable but unoccupied habitat.	Single location in Sussex County	Bi-annual	WS
Rare Skipper	Y	Habitat quality and persistence for known population. Also surveys of suitable but unoccupied habitat.	Single location in Kent County	Annual	WS
Farming for Native Bees		Surveying native bees associated with cucurbit/mixed organic crops in Delaware.	Statewide.	2007-10	PI
<b>Fish</b>					
Adult, sub-adult and juvenile estuarine fish & shellfish	P	30 foot trawl in nine fixed plots (adults and sub-adults) and 16 foot trawl in 51 fixed plots (juveniles) to determine status and trends.	Delaware Bay (all) & Inland Bays (juveniles only)	Monthly, Mar-Dec (adults & sub-adults), Apr-Oct (juveniles)	FS
Freshwater fish	P	Electrofishing of fixed plots to determine status and trends. Also, collection of data on water quality, physical stream characteristics, riparian vegetation and landscape context.	Freshwater streams statewide	Every 3-5 years (planned)	WS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Striped Bass	N	Electrofishing, trawling, and sampling of recreational and commercial landings to determine age, size, sex composition and food habits.	Delaware Bay	Various: mostly weekly in spring and fall	FS
American Shad	N	Tagging, electrofishing, seining and sampling of commercial landings to determine abundance of juveniles and adults and age, size and sex composition of adults.	Nanticoke River and Delaware River & Bay	Various: weekly or monthly, spring or summer and fall	FS
Hickory Shad	Y	Tagging, electrofishing and seining to determine abundance of juveniles and adults.	Nanticoke River	Weekly, summer and fall	FS
Blueback Herring & Alewife	N	Seining to establish index of year class strength.	Nanticoke River	Weekly, summer and fall	FS
American Eel	Y	Fyke nets and sampling of commercial landings to determine abundance of elvers and age and size of adults.	Nanticoke River and Delaware River & Bay	Various: weekly or monthly, spring or summer	FS
Freshwater sportfish	N	Electrofishing to determine abundance, size structure, community indices, and growth rates.	Selected lakes/ponds statewide	5 years	FS
Smallmouth Bass	N	Electrofishing to determine abundance, growth rate and size structure.	Brandywine River	Monthly, summer and fall	FS
Largemouth Bass	N	Tagging and electrofishing to determine abundance, size and age structure.	Selected tidal freshwater streams	Annual or semi-annual, summer and fall	FS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Weakfish	N	Trawling to determine abundance and food habits. Tagging study being planned.	Delaware Bay & Inland Bays	Various: weekly or monthly, Mar-Dec or summer-fall	FS
Atlantic Menhaden	N	Trawling to determine abundance and size structure of juveniles.	Inland Bays	Weekly, June-Sept	FS
Atlantic Sturgeon	Y	Gill netting and tagging to determine abundance, size distribution and stock ID of juveniles.	Delaware River	3 years minimum, June-Oct	FS
Fish Monitoring Study	P	Seine net sampling to determine the numbers of fish by species.	Inland bays and tributaries	Twice monthly	CIB
<b>Amphibians</b>					
Frogs and toads	P	<i>Delaware Amphibian Monitoring Project.</i> Call surveys on fixed routes to determine status and trends.	Statewide	Annual	WS
Salamanders	P	<i>Forest Health Monitoring.</i> Cover boards in fixed plots to determine status and trends.	Statewide	Annual	FSV
<b>Reptiles</b>					
Bog Turtle	Y	Ground surveys and trapping of suitable habitat.	New Castle County	Annual	WS
<b>Birds</b>					
Breeding birds	P	<i>Breeding Bird Survey.</i> Counts of ¼ mile radius around fixed points on 8 fixed routes to determine status and trends.	Statewide	Annual	DOS
Breeding birds	P	<i>Breeding Bird Atlas.</i> Surveys for evidence of breeding in USGS blocks (in 7.5 minute topographic quad).	Statewide	2008-2012	DOS

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Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Winter birds	P	<i>Christmas Bird Count.</i> Counts along fixed routes within 15 mile radius around 7 fixed points to determine status and trends.	Statewide	Annual	DOS
Veery	Y	Banding and observation of nests to determine productivity.	Single location in New Castle County	Annual	WS
Bald Eagle	Y	Aerial and ground surveys of known nest sites. Also aerial and ground surveys of suitable but unoccupied habitat.	Statewide	Annual	WS
Forest-dependent songbirds	P	Counts of 50m radius around fixed points to determine status and trends.	Selected conservation lands statewide	Annual or bi-annual	WS
Wood Thrush	Y	Banding and observation of nests to determine productivity for isolated population.	Single location in New Castle County	Annual	UD
Coastal Plain Swamp Sparrow	Y	Banding and observation of nests to determine productivity.	Selected locations in Kent County	Annual	SMBC
Waterfowl	P	Aerial surveys of fixed transects to determine abundance. Aerial and ground surveys of random plots to determine nesting success.	Statewide	Annual, Oct-Jan (transects) or Apr-May (plots)	WS
Bobwhite	Y	Call surveys on fixed routes to determine abundance.	Selected State Wildlife Areas	Annual	WS
Mourning Dove	N	Call survey on fixed route to determine abundance.	New Castle County	Annual	WS
American Woodcock	Y	Call surveys on fixed routes to determine abundance.	New Castle and Sussex Counties	Annual	WS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Marsh-nesting songbirds and rails	P	Banding and observation of nests to determine distribution and abundance.	Selected conservation lands statewide	Annual (planned)	WS
Migratory shorebirds	P	Delaware Shorebird Project. Banding, aerial surveys and ground surveys to determine status, trends and health.	Selected coastal areas	Annual, spring & fall	WS
Long-legged waders	P	Ground survey of evening flights and ground and aerial surveys of nests to determine status and trends.	Pea Patch Island Heronry	Monthly, Feb-Aug (evening flights) or annual (nest surveys)	OMS
Migratory raptors	P	Hawkwatch. Counts of passing birds to determine status and trends.	Ashland, Cape Henlopen and White Clay Creek State Parks	Annual, spring & fall (CHSP) or fall (WCCSP)	SBC (CHSP) & CRSS (WCCSP)
Beach-nesting birds	Y	Ground surveys of suitable habitat. Observation of nests to determine productivity.	Selected Delaware Bay beaches	Daily, Apr-Aug	WS
American Oystercatcher	Y	Ground surveys of suitable habitat. Observation of nests and banding of nestlings to determine migration, dispersal and productivity.	Inland Bays beaches	2-3 years (planned)	WS
Osprey	Y	Aerial and ground observation and of nests and banding of nestlings to determine status, trends and productivity.	Statewide	3 years	WS
Peregrine Falcon	Y	Observation of nests and banding of nestlings to determine productivity.	Statewide	Annual	USFWS
Barn Owl	Y	Banding at nest boxes.	State wildlife areas and national wildlife refuge	Annual	WS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Salt Marsh Bird Community	Y	Abundance, fecundity and survival.	Selected locations in Northeast states	Annual	UD
Marsh-nesting songbirds and rails	P	Point count and callback survey of tidal marsh passerines and secretive marshbirds, per the Saltmarsh Habitat and Avian Research Program (SHARP) protocol	Coastal DE NWR Complex (Prime Hook & Bombay Hook NWRs)	Annual	USFWS, WS
Migrating and wintering waterbirds (waterfowl, shorebirds, and wading birds)	P	Area counts of all waterbirds during fall, winter, and spring, including assessment of habitat conditions, per the Integrated Waterbird Management and Monitoring (IWMM) Program	Coastal DE NWR Complex (Prime Hook & Bombay Hook NWRs)	Annual	USFWS, DNREC
<b>Mammals</b>					
Delmarva Fox Squirrel	Y	Trapping, tagging and nest box surveys to determine status and trends.	Prime Hook NWR and Nanticoke Wildlife Area	Annual (nest boxes) or 2-5 years (trapping)	WS
Bat surveys	Y	Acoustic monitoring, white-nose syndrome monitoring, and size and location of maternity colonies statewide,	Statewide	Annual	WS
<b>Habitats</b>					
Estuarine wetlands	P	Water chemistry to determine habitat condition including temperature, specific conductivity, salinity, dissolved oxygen concentration, dissolved oxygen percent saturation, pH, turbidity, and depth.	Inland Bays, Broadkill River, Blackbird Creek and St. Jones River	Annual	CIB and DNERR



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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Wetlands	P	<p><a href="#">DECAP - The Delaware Comprehensive Assessment Procedure</a> is a comprehensive assessment method for collecting data used to determine the condition of a wetland site relative to reference condition. DECAP can be used to assess flat, riverine and depressional nontidal wetland subclasses in the Coastal Plain of Delaware and Maryland.</p> <p><a href="#">DERAP - The Delaware Rapid Assessment Procedure</a> is a rapid field method to determine the general condition of a wetland sites</p>	<p>Statewide</p> <p>Flat, riverine, and depressional wetlands in Delaware</p>	Ongoing	DNREC Watershed Assessment Section and Partners
Estuarine Emergent Tidal Wetlands	P	<p><a href="#">MidTRAM - The MidAtlantic Tidal Rapid Assessment Method</a> is a rapid protocol for assessing the condition of estuarine emergent tidal wetlands. The MidTRAM is validated with intensive biological data based on the bird community and biomass levels</p>	Estuarine emergent tidal wetlands in Delaware, Maryland, and Virginia	Ongoing	DNREC Watershed Assessment Section and Partners

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Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Non-tidal streams	P	Physical stream characteristics, macroinvertebrates and periphyton using EPA Rapid Bioassessment Protocols in 50 fixed transects to determine stream condition.	Non-tidal streams statewide	Annual (physical, inverts) or bi-annual (periphyton)	ELS
Streams	P	<i>Delaware Stream Watch</i> . Water chemistry and macroinvertebrates to determine stream condition.	Statewide	Annual	DNS
Forests	P	<i>Forest Health Monitoring</i> . Forest type, stand age, regeneration and disturbance; tree species, height and diameter; shrub and herbaceous layers composition; etc. at fixed plots to determine forest condition.	Statewide	Annual	FSV
Saltmarshes	P	Comprehensive salt marsh integrity (SMI) index assessment, including landscape, vegetation, surface elevation table (SET), and water level data collection (in conjunction with SHARP bird surveys, referenced above)	Coastal DE NWR Complex (Prime Hook & Bombay Hook NWRs)	Every 3-5 years (SETs seasonally or annually)	USFWS
Refuge Wetland Hydrology & Water Quality	P	Water level and water quality (parameters vary by refuge) monitoring via network of sondes, and in some cases grab sampling	Coastal DE NWR Complex (Prime Hook & Bombay Hook NWRs)	Continuous	USFWS with CMP, UD
Refuge Shoreline	P	Refuge Shoreline Position and Topography (planned) monitoring per National Park Service protocols	Prime Hook NWR	Spring and Fall	USFWS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Benthic	P	<i>Delaware Estuary Benthic Inventory.</i> Sediment, water quality, fauna, metals, and hard bottom data.	Delaware Basin	2008-09	PDE
Vegetation Mapping	P	Delaware Statewide Vegetation Community Mapping Project.	Statewide	Quarterly	WS
Species and Habitat Monitoring	P	<i>Prime Hook National Wildlife Refuge Comprehensive Conservation Planning.</i> Monitoring for invasive plants, rare species, climate change, breeding birds etc.	Refuge	3-5 years	USFWS
Mosquito Sampling Programs		Techniques used to measure mosquito abundance and the presence of mosquito transmitted diseases	Statewide	ongoing	DNREC DFW- Mosquito Control Section
Conservation Issues					
Vehicles from transportation operations		Roadside/roadkill survey of Diamondback Terrapin to determine mortality rate and effectiveness of fencing.	Rt. 1, Delaware Seashore State Park	Daily, June-July	CIB
Excessive herbivory by White-tailed Deer		Spotlight surveys along fixed routes to determine status and trends. Exclosures to determine impacts of herbivory.	Selected State Parks, Forests and Wildlife Areas; DNS Preserves	Annual	OMS (parks), FSV (forests), WS (wildlife areas), DNS (preserves)
Excessive herbivory and nutrification by Resident Canada Goose		Aerial surveys of fixed transects to determine abundance. Ground surveys of nests.	Statewide (aerial surveys) or State Parks (ground surveys)	Annual	OMS
Habitat degradation by invasive plants		Qualitative ground surveys to determine presence/absence of invasive plants.	Selected State Parks	Annual	OMS

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Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Chronic water pollution from residential and commercial development practices, agricultural and forestry operations, industrial operations and transportation operations		Contaminant sampling of osprey nestlings.	Statewide	6 years (planned)	WS
Chronic water pollution from residential and commercial development practices, agricultural and forestry operations, industrial operations and transportation operations		Water chemistry, organics, biological oxygen demand, nutrients, metals and bacteria at 250+ fixed stations to determine water quality of streams and ponds.	Statewide	Quarterly	WAS
Chronic water pollution from residential and commercial development practices, agricultural and forestry operations, industrial operations and transportation operations		Water chemistry, organics, biological oxygen demand, pollutants, etc. of point discharges to enforce permit compliance.	Statewide	Various: monthly to bi-annual	SWDS

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Existing/Planned Monitoring Programs for Species, Habitats and Conservation Issues					
Species/Habitat/Issue	SGCN/KW H*	Description	Location	Frequency	Responsible Party**
Chronic water pollution from residential and commercial development practices, agricultural and forestry operations, industrial operations and transportation operations		Public water supply monitoring of surface water and groundwater	Statewide	Various	WSS
Chronic water pollution from agricultural operations		Pesticides using monitoring wells to determine groundwater quality.	Statewide	Annual	PMS
Groundwater withdrawals for water use		Salinity levels using monitoring wells to determine saltwater intrusion into aquifers.	New Castle and Sussex Counties	Annual	WSS & DGS
Groundwater withdrawals for water use		Groundwater levels using monitoring wells to determine aquifer status.	Statewide	Annual	DGS
Surface water withdrawals for water use		Stream flows at 20+ fixed gaging stations to determine hydrology.	Statewide	Continuous	USGS
Air pollution from industrial operations		NO <sub>x</sub> , SO <sub>x</sub> , particulates, ozone, etc. at 9 fixed stations to determine air quality.	Statewide	Continuous	AQMS
Air pollution from industrial operations		Pollutants at 1000+ sites to enforce permit compliance.	Statewide	Various	AQMS

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\*SGCN = Species of Greatest Conservation Need; KWH = Key Wildlife Habitat; Y = Yes, N = No, P = In Part

\*\*Source abbreviations:

AQMS	=	Air Quality Management Section, Delaware Division of Air and Waste Management
AREC	=	Aquatic Resources Education Center, Delaware Division of Fish and Wildlife
CIB	=	Center for the Inland Bays
CMP	=	Coastal Management Program, Delaware Division of Soil and Water Conservation
CRSS	=	Cultural and Recreational Services Section, Delaware Division of Parks and Recreation
DGS	=	Delaware Geological Survey
DOS	=	Delmarva Ornithological Society
DNERR	=	Delaware National Estuarine Research Reserve, Delaware Division of Soil and Water Conservation
DNS	=	Delaware Nature Society
ELS	=	Environmental Laboratory Section, Delaware Division of Water Resources
ERDG	=	Ecological Research and Development Group, Inc.
FS	=	Fisheries Section, Delaware Division of Fish and Wildlife
FSV	=	Forest Service, Delaware Department of Agriculture

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OMS	=	Operations and Maintenance Section, Delaware Division of Parks and Recreation
PDE	=	Partnership for the Delaware Estuary
PI	=	Plant Industries, Delaware Department of Agriculture
PMS	=	Pesticide Management Section
SBC	=	Sussex Bird Club
SMBC	=	Smithsonian Migratory Bird Center
SWDS	=	Surface Water Discharges Section, Delaware Division of Water Resources
UD	=	University of Delaware
USFWS	=	U.S. Fish and Wildlife Service
USGS	=	U.S. Geological Survey
WAS	=	Watershed Assessment Section, Delaware Division of Water Resources
WS	=	Wildlife Section, Delaware Division of Fish and Wildlife
WSS	=	Water Supply Section, Delaware Division of Water Resources





